

CLAIMS

What is claimed is:

1. A surface-profiling method comprising:
projecting a two-dimensional pattern of alternating relatively lighter and relatively darker regions upon a surface at a first angle relative to said surface;
capturing an image of said pattern from a second angle relative to said surface; and
processing said image to produce a profile of said surface.
2. A surface-profiling method as claimed in claim 1 wherein:
said projecting activity projects discrete multiple ones of said patterns;
said capturing activity captures an image of each of said patterns; and
said processing activity processes each of said images.

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3. A surface-profiling method as claimed in claim 1, wherein said pattern has a length and a width, said method additionally comprising:

affixing to a vehicle a projector configured to effect said projecting activity, wherein said vehicle is configured to move in a vehicular direction and said projector is configured to project said pattern so that said width is substantially perpendicular to said vehicular direction;

affixing to said vehicle a camera configured to effect said capturing activity; and

moving said vehicle over said surface in said vehicular direction while effecting said projecting and capturing activities so as to obtain said captured image.

4. A surface-profiling method as claimed in claim 3 additionally comprising:

repeating said projecting and capturing activities at intervals along said vehicular direction to obtain a series of said captured images; and

deriving a profile of said surface in substantially said vehicular direction from said series of said captured images.

5. A surface-profiling method as claimed in claim 1 wherein said processing activity comprises:

producing an image signal in response to said image; and

correlating said image signal with a reference signal to produce said profile of said surface.

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6. A surface-profiling method as claimed in claim 5 additionally comprising configuring said reference signal to correspond to said pattern projected by said projecting activity.

7. A surface-profiling method as claimed in claim 1 additionally comprising:

partitioning said image into at least one image region, wherein one said image region is responsive to a portion of said pattern projected upon said surface;

producing an image signal in response to said one image region;

correlating said image signal with a reference signal configured to correspond to said image region to produce a correlation signal; and

determining, in response to said correlation signal, a relative height of said surface upon which said portion of said pattern was projected.

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8. A surface-profiling method as claimed in claim 1 additionally comprising:

partitioning said image into at least twenty-five image regions, wherein one of said image regions is responsive to a portion of said pattern projected upon said surface;

producing an image signal in response to said one image region;

correlating said image signal with a reference signal configured to correspond to said one image region to produce a correlation signal; and

determining, in response to said correlation signal, a relative height of said surface upon which said portion of said pattern was projected.

9. A surface-profiling method as claimed in claim 1 additionally comprising:

partitioning said image into at least twenty five image regions, wherein each of said image regions is responsive to a portion of said pattern projected upon said surface;

producing a plurality of image signals, wherein one of said image signals is produced in response to each of said image regions;

correlating each of said image signals with a reference-band signal configured to correspond to said each image region to produce a correlation signal;

determining, in response to each of said correlation signals, a relative height of said surface upon which said portion of said pattern was projected; and

producing said surface profile from said plurality of relative heights.

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10. A surface-profiling method as claimed in claim 1 wherein said surface has a longitudinal direction and a transverse direction substantially perpendicular to said longitudinal direction, wherein said two-dimensional pattern has a length and a width, wherein said projecting activity projects said two-dimensional pattern so that said length of said pattern is substantially coincident with said longitudinal direction of said road surface and said width of said pattern is substantially coincident with said transverse direction of said road surface, and wherein said surface-profiling method additionally comprises:

partitioning said image into at least one image region, wherein said image region is responsive to a portion of said pattern projected upon said surface in said transverse direction;

producing an image signal in response to said one image region;

correlating said image signal with a reference signal configured to correspond to said image region to produce a correlation signal;

determining, in response to said correlation, a relative height of said surface upon which said portion of said pattern was projected;

repeating said projecting, capturing, partitioning, producing, correlating, and determining activities multiple times to produce a series of said relative heights of said road surface transverse profiles of said road surface; and

deriving a longitudinal profile of said road surface from said series of said relative heights of said road surface.

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11. A surface-profiling system comprising:

a projector configured to project a two-dimensional pattern of alternating relatively lighter and relatively darker regions upon a surface from a first angle;

a camera configured to capture an image of said projected pattern from a second angle; and

a computer configured to produce a profile of said surface from said captured image.

12. A surface-profiling system as claimed in claim 11 wherein said pattern comprises:

at least three of said relatively lighter regions extending across a width of said pattern; and

at least two of said relatively darker regions extending across said width of said pattern, wherein each of said relatively darker regions is positioned between adjacent ones of said relatively lighter regions, and wherein said relatively lighter regions and said relatively darker regions together form a length of said pattern substantially perpendicular to said width thereof.

13. A surface-profiling system as claimed in claim 12 wherein:

said surface is a road surface having a longitudinal direction and a transverse direction substantially perpendicular to said longitudinal direction;

said two-dimensional pattern is projected upon said road surface so that said width of said pattern is substantially coincident with said transverse direction of said surface; and

said profile is a transverse profile of said road surface.

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14. A surface-profiling system as claimed in claim 13 wherein:

said projector, camera, and processor are together configured to produce a series of said transverse profiles wherein each of said transverse profiles in said series is a transverse profile at a different distance along said longitudinal direction of said road surface; and

said computer is additionally configured to derive a longitudinal profile of said road surface from said series of said transverse profiles.

15. A surface-profiling system as claimed in claim 11 wherein:

said two-dimensional pattern has a width and a length;

said camera is a first camera configured to capture a first image of said pattern over a first portion of said width;

said system comprises a second camera configured to capture a second image of said pattern over a second portion of said width;

said computer is configured to integrate said first and second captured images and produce a profile of said surface therefrom.

16. A surface-profiling system as claimed in claim 11 wherein:

said projector is configured to project said pattern with said relatively lighter regions of substantially a predetermined monochromaticity; and

said camera is filtered to be sensitive to said relatively lighter regions of substantially said predetermined monochromaticity.

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17. A surface-profiling system as claimed in claim 16 wherein:

said projector comprises a laser; and

said laser produces said relatively lighter regions of substantially said predetermined monochromaticity.

18. A surface-profiling system as claimed in claim 16 wherein said projector is a stroboscopic projector.

19. A surface-profiling method as claimed in claim 11 wherein said two-dimensional pattern is formed of a plurality of said relatively lighter regions separated by said relatively darker regions and projected over a width of said pattern, and has a length substantially perpendicular to said width.

20. A surface-profiling method as claimed in claim 11 wherein said two-dimensional pattern is configured to have a higher mathematical autocorrelation function in one direction.

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21. A surface-profiling system comprising:

a vehicle configured to move in a vehicular direction upon a surface having a longitudinal direction and a transverse direction substantially perpendicular to said longitudinal direction, said vehicular direction being substantially coincident with said longitudinal direction;

a projector affixed to said vehicle and configured to project a series of two-dimensional patterns of alternating relatively lighter and relatively darker regions upon said surface as said vehicle moves in said vehicular direction, wherein said patterns are projected at a first angle substantially perpendicular to said surface, and wherein said patterns have a length and a width, said width being substantially coincident with said transverse direction;

a camera affixed to said vehicle and configured to capture images of said projected patterns from a second angle oblique to said surface as said vehicle moves in said vehicular direction; and

a computer configured to produce a transverse profile of said surface from each of said captured images and configured to derive a longitudinal profile of said surface from a plurality of said transverse profiles.

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